

CATALOGED BY DDC  
AS AD No. 402621

63-4-1

GD ID

GENERAL DYNAMICS | CONVAIR

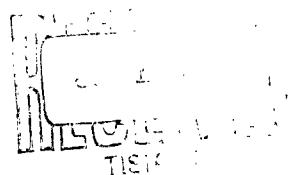
Report No. 8926-170

Material - Titanium - Commercially Pure, Ti 6Al-4V, Ti 5Al-2½ Sn

Static and Fatigue Strength of Dissimilar Alloy Spotwelds

E. K. Winslow, G.D. Lindeneau, W. E. Wise

18 April 1957



Published and Distributed  
under  
Contract AF33(657)-8926

Post Office Box 1950, San Diego 12, California 296-6611  
Material Post Office Box 2071 273-8000 | Accounting Post Office Box 510



MODEL  
DATE

PAGE  
REPORT NO.

Report No. 8926-170

Material - Titanium - Commercially Pure, Ti 6Al-4V, Ti 5Al-2½ Sn

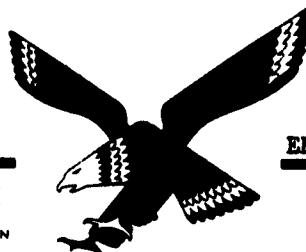
Static and Fatigue Strength of Dissimilar Alloy Spotwelds

Abstract:

Three spotwelded, lap seam combinations comprised of (1) 0.025" thick Ti 6Al-4V and 0.025" thick commercially pure titanium; (2) 0.025" thick Ti 5Al-2½ Sn and 0.025" thick commercially pure titanium; and, (3) 0.025" thick Ti 6Al-4V and 0.025" thick Ti 5Al-2½ Sn titanium were tension-shear, cross-tension and fatigue tested. The average tension - shear strengths of combinations (1), (2) and (3) were 908, 955 and 959 pounds per spot, respectively, and the average cross-tension strengths were 302, 236 and 275 pounds per spot, respectively. The respective tension-shear cross-tension ratios were 0.33, 0.25, and 0.29. The fatigue strengths for  $10^7$  cycles life were 53, 86 and 97 pounds per spot, respectively.

Reference: Winslow, E. K., Haney, R. J., Wise, W. E., "Spot-welded Titanium - Alpha and Alpha-Beta Alloy .025" Gage Sheet Combination - Shear, Tension and Fatigue Properties," General Dynamics/Convair Report SL 56-287, San Diego, California, 18 April 1957. (Reference attached).

**CONVAIR**  
A DIVISION OF GENERAL DYNAMICS CORPORATION  
SAN DIEGO



ENGINEERING TEST LABORATORIES

REPORT 56-827

DATE 18 April 1957

MODEL F-102A

TITLE

REPORT NO. 56-827  
SPOTWELDED TITANIUM  
ALPHA AND ALPHA-BETA ALLOY  
.025" GAGE SHEET COMBINATION  
SHEAR, TENSION, AND FATIGUE PROPERTIES  
MODEL F-102A

CONTRACT NO. AF 33(600)-31174

PREPARED BY E. K. Winslow

E. K. Winslow

R. J. Honey

for G. D. Lindenau

CHECKED BY W. E. Wise

W. E. Wise

WITNESS:

S. R. Carpenter

NO. OF PAGES 17

NO. OF DIAGRAMS 13

GROUP STRUCTURES LABORATORIES

REFERENCE

APPROVED BY E. F. Strong

E. F. Strong  
Chief, Engineering  
Test Laboratories

USAF

REVISIONS

NO.	DATE	BY	CHANGE	PAGES AFFECTED
.				
99				

ANALYSIS

PREPARED BY E. K. Winslow  
CHECKED BY W. E. Wise  
REVISED BY

**C O N V A I R**  
A DIVISION OF GENERAL DYNAMICS CORPORATION  
SAN DIEGO

PAGE 1  
REPORT NO. 56-827  
MODEL F-102A  
DATE 18 April 1957

REPORT NO. 56-827  
SPOTWELDED TITANIUM  
ALPHA AND ALPHA-BETA ALLOY  
.025" GAGE SHEET COMBINATION  
SHEAR, TENSION, AND FATIGUE PROPERTIES  
MODEL F-102A

REFERENCES:

- (a) Convair Specification 0-05003. "Welding - Spot and Seam. Commercially Pure and All Alpha Titanium Alloy."
- (b) TML Report No. 31. "Welding of Titanium and Titanium Alloys." Battelle Memorial Institute, Titanium Metallurgical Laboratory. 7 February 1956.
- (c) Convair Report No. 9748. "Spotwelding of 6AL4V Titanium Alloy". Shear, Tension, and Fatigue Characteristics. 6 October 1955.

OBJECT:

To determine and evaluate the tension, shear, and fatigue properties of alpha and alpha-beta titanium alloys, spotwelded in the following .025" gage sheet material combinations:

- a. Commercially Pure (alpha) to 6AL4V (alpha-beta).
- b. Commercially Pure (alpha) to 5 Al 2 $\frac{1}{2}$  SN (alpha).
- c. 5 Al 2 $\frac{1}{2}$  SN (alpha) to 6 AL4V (alpha-beta).

CONCLUSIONS:

1. Shear strength and weld nugget quality for each required sheet combination met Convair Specification 0-05003.
2. Tension-shear ratio, an indicator of weld ductility, was .25 or above for all sheet combinations and comparable to commercially pure and all alpha titanium.
3. Fatigue strengths (pounds/spot) of 5 AL 2 $\frac{1}{2}$  SN - Commercially Pure and 6AL4V - Commercially Pure lap joints were 88% and 55%, respectively, the fatigue strength of 5 AL 2 $\frac{1}{2}$  SN - 6AL4V lap joints at the endurance limit. (Based on SN - Curve Comparison).

RECOMMENDATIONS:

It is recommended that spotwelded .025" - .025" commercially pure titanium lap joints be tested in fatigue for the purpose of comparison with fatigue test results reported here.

ANALYSIS  
PREPARED BY E. K. Winslow  
CHECKED BY W. E. Wise  
REVISED BY

CONVAIR  
A DIVISION OF GENERAL DYNAMICS CORPORATION  
SAN DIEGO

PAGE 2  
REPORT NO. 56-827  
MODEL F-102A  
DATE 18 April 1957

TEST SPECIMENS AND PROCEDURE:

The following titanium sheet materials, .025" gage, were used for test specimen manufacture.

1. Commercially Pure (alpha) - MST III from Mallary Sharon. Heat number HT-25268 (AMS4901).
2. 6AL4V (alpha-beta) - titanium alloy sheet from Titanium Metals Corp. Heat number M-4274.
3. 5 AL 2 $\frac{1}{2}$  SN (alpha) - titanium alloy sheet from Titanium Metals Corp. Heat number M-4384.

The chemical composition and physical properties of 6AL4V, according to the manufacturer, were as follows:

Aluminum	6.07%
Vanadium	4.05%
Carbon	.01%
Iron	.118%
Nitrogen	.011%
Hydrogen	.012%
Titanium	Balance

Tensile yield strength	Longitudinal grain	128,330 psi
Tensile yield strength	Transverse grain	130,000 psi
Ultimate Tensile strength	Longitudinal grain	142,900 psi
Ultimate Tensile strength	Transverse grain	147,730 psi
Elongation	Longitudinal grain	7%
Elongation	Transverse grain	9.0%

The chemical composition and physical properties of MST III (AMS 4901) and 5 AL 2 $\frac{1}{2}$  SN were not available.

Specimen material was prepared for spotwelding as follows:

1. Vapor degrease
2. Alkaline cleaner
3. Hot H<sub>2</sub>O rinse
4. Titanium etch
5. Cold H<sub>2</sub>O rinse
6. Oakite #34 etch
7. Hot H<sub>2</sub>O rinse
8. Vapor degrease

ANALYSIS

PREPARED BY E. K. Winslow  
CHECKED BY W. E. Wise  
REVISED BY

C O N V A I R  
A DIVISION OF GENERAL DYNAMICS CORPORATION  
SAN DIEGO

PAGE 3  
REPORT NO. 56-827  
MODEL F-102A  
DATE 18 April 1957

Hydrogen analysis of test materials was made in the as received and as etched conditions by Process Control Laboratory, Dept 27, Plant 2.

Shear and tension specimen drawings and specifications are shown in Figure 1 and fatigue specimen drawings are shown in Figure 2.

Specimens were spotwelded to give the following:

1. 60% to 80% penetration.
2. Sound nuggets.
3. .003 inches or less electrode indentation.
4. Free of surface burns and electrode pick up.
5. Sheet separation less than .005 inches.

Spotwelding machine settings are shown in Table I.

Tension and shear specimens were tested in a 12,000 pound Tinius Olsen Electromatic testing machine.

Fatigue specimens were tested in a Sonntag SF-1U fatigue machine at load levels (pounds/spot) and load ratios shown in Tables III, IV, and V. The fatigue test set-up is shown in Figure 3.

#### RESULTS AND DISCUSSION:

The results of tension and shear tests are given in Table II together with tension-shear ratio values.

Fatigue test results are shown in Tables III, IV and V. S-N curves of the three specimen types tested are shown in Figures 4, 5, and 6.

The results of the hydrogen analysis of specimen material was as follows:

<u>Material</u>	<u>Hydrogen %</u>	<u>Condition</u>
MST III	.0063	As received
MST III	.0061	As etched
5Al 2 $\frac{1}{2}$ SN	.0081	As received
5Al 2 $\frac{1}{2}$ SN	.0089	As etched
6 AL 4V	.0091	As received
6 AL 4V	.0085	As etched

ANALYSIS

PREPARED BY E. K. Winslow  
CHECKED BY W. E. Wise  
REVISED BY

**CO N V A I R**  
A DIVISION OF GENERAL DYNAMICS CORPORATION  
SAN DIEGO

PAGE 4  
REPORT NO. 56-827  
MODEL F-102A  
DATE 18 April 1957

The shear loads and weld nugget quality of test specimens in all cases met Convair Specification 0-05003. This specification requires a minimum allowable single spot shear strength of 595 pounds and lowest average single spot shear of 745 pounds.

The tension-shear ratio, an indicator of weld ductility, was .25 or better for all specimen types based on average values. Reference (b) indicates tension-shear ratios of .25 to .40 to be satisfactory for commercially pure titanium in most service applications. Reference (c) indicates tension-shear ratios of .25 or better to be satisfactory for commercially pure and all alpha titanium alloys.

Figure 7 shows comparative S-N curves of specimen groups.

The fatigue strength (pounds/spot) of 6AL4V - commercially pure and 5 Al 2 $\frac{1}{2}$  SN - commercially pure lap joints were 55% and 88%, respectively, the fatigue strength (pounds/spot) of 5 Al 2 $\frac{1}{2}$  SN - 6AL4V lap joints at the endurance limit.

Fatigue failures of all specimen groups tested were of types found in previous tests. Description of these failures are given in the remarks section of Tables III, IV and V. Photographs, representative of spot-weld failure usually encountered in fatigue work, may be found in Reference (c) Figure 8. This figure is shown in Figure 8 for convenient reference.

NOTE:

The data from which this report was prepared are recorded in Engineering Test Laboratories Data Book Nos. 874, page 2, and 4025 page 5.

TABLE I

PAGE 5  
REPORT NO. 56-827  
DATE 18 April 1957

MACHINE SETTINGS FOR SPOTWELDING TITANIUM ALLOYS - Ti-GAL-4V, Ti-SAL-2.5 SN, MST-III									
SHEET COMBINATION	.025 GAL-4V TO .025 MST-III	SHEET COMBINATION	.025 SAL-2.5 SN TO .025 MST-III	SHEET COMBINATION	.025 CAL-4V TO .025 SAL-2.5 SN				
THROAT DEPTH	36"	THROAT DEPTH	35 1/2"	THROAT DEPTH	35 1/2"				
DIST. BETWEEN ARMS	6"	DIST. BETWEEN ARMS	6 1/2"	DIST. BETWEEN ARMS	6 1/2"				
WELD TIME	52 MIL SEC.	WELD TIME	1 CYCLE	WELD TIME	1 CYCLE				
HOLD TIME	150 MIL SEC.	HOLD TIME	5 CYCLES	HOLD TIME	5 CYCLES				
SQUEEZE TIME	167 MIL SEC.	SQUEEZE TIME	10 CYCLES	SQUEEZE TIME	10 CYCLES				
TRANS. TAP SETTING	WYE-HIGH 7-8	OFF TIME	25 CYCLES	OFF TIME	25 CYCLES				
PRESSURE	20 PSI	TRANS. TAP SETTING	DELTA LOW 8	TRANS. TAP SETTING	DELTA LOW 8				
INITIAL FORCE	500 LB.	PRESSURE	100 PSI	PRESSURE	100 PSI				
FINAL FORCE	NONE-SINGLE-LOW (INITIAL)	INITIAL FORCE	300 LBS.	INITIAL FORCE	300 LBS.				
ELECTRODES :	TOP BOTTOM	FINAL FORCE	NONE	FINAL FORCE	NONE				
CLASS	III	PRESSURE SELECTOR	SINGLE-LOW	PRESSURE SELECTOR	SINGLE-LOW				
DIAM.	3/4"	WELD HEAT LEVEL	100%	WELD HEAT LEVEL	90%				
CONTOUR	4" R	ELECTRODES :	TOP BOTTOM	ELECTRODES :	TOP BOTTOM				
MACHINE *5, PLANT II, BLDG. I	SERIAL NO. 53339	CLASS	II	CLASS	II				
USAF 603064	100 KVA TAYLOR WINFIELD	DIAM.	1/2"	DIAM.	1/2"				
MACHINE *6, PLANT II, BLDG. I	SERIAL NO. 41632	CONTOUR	4" R	CONTOUR	4" R				
USAF 640199	100 KVA TAYLOR WINFIELD								
		MACHINE *6, PLANT II, BLDG. I		MACHINE *6, PLANT II, BLDG. I					
		SERIAL NO. 41632		SERIAL NO. 41632					
		USAF 640199		USAF 640199					
		100 KVA TAYLOR WINFIELD		100 KVA TAYLOR WINFIELD					

TABLE II

## MECHANICAL PROPERTIES OF SPOT WELDED TITANIUM ALLOYS - Ti-6Al-4V, Ti-5Al-2.5Sn &amp; MST-III

SPEC. C. NO.	SHEET GAGE	COMBINATION	SHEAR TEST		SPEC. NO.	SHEET GAGE	TENSION TEST		TENS/ SHEAR RATIO	
			SHEAR STR.	Avg. SHEAR NOTES			COMBINATION	TENSILE STR.		
1	.025	6Al-4V	890		PULLED	1	.025	6Al-4V	313	
2	.025	MST-III	986	"		2	.025	MST-III	418	
3				N.G.		3				
4			931	808	PULLED	4				
5			901			5				
6			911			6				
7			853			7				
8			865			8				
9						9				
10					PULLED	10				
11	.025	Ti-2.5Sn	1095			11				
12	.025	MST-III	1040			12	.025	MST-III	249	
13			990			13				
14			913	955		14				
15			665			15				
16			930			16				
17			855			17				
18			1	N.G.		18				
19					PULLED	19				
20	.025	6Al-4V	1005			20				
21	.025	Ti-2.5Sn	995			21				
22			998			22				
23			1			23				
24			970	959		24				
25			997			25				
26			898			26				
27			925			27				
28			1	880		28				
29						29				
30						30				
31						31				
32						32				
33						33				
34						34				
35						35				
36						36				
37						37				
38						38				
39						39				
40						40				
41						41				
42						42				
43						43				
44						44				
45						45				
46						46				
47						47				
48						48				
49						49				
50						50				
51						51				
52						52				
53						53				
54						54				
55						55				
56						56				
57						57				
58						58				
59						59				
60						60				
61						61				
62						62				
63						63				
64						64				
65						65				
66						66				
67						67				
68						68				
69						69				
70						70				
71						71				
72						72				
73						73				
74						74				
75						75				
76						76				
77						77				
78						78				
79						79				
80						80				
81						81				
82						82				
83						83				
84						84				
85						85				
86						86				
87						87				
88						88				
89						89				
90						90				
91						91				
92						92				
93						93				
94						94				
95						95				
96						96				
97						97				
98						98				
99						99				
100						100				
101						101				
102						102				
103						103				
104						104				
105						105				
106						106				
107						107				
108						108				
109						109				
110						110				
111						111				
112						112				
113						113				
114						114				
115						115				
116						116				
117						117				
118						118				
119						119				
120						120				
121						121				
122						122				
123						123				
124						124				
125						125				
126						126				
127						127				
128						128				
129						129				
130						130				
131						131				
132						132				
133						133				
134						134				
135						135				
136						136				
137						137				
138						138				
139						139				
140						140				
141						141				
142						142				
143						143				
144						144				
145						145				
146						146				
147						147				
148						148				
149						149				
150						150				
151						151				
152						152				
153						153				
154						154				
155						155				
156						156				
157						157				
158						158				
159						159				
160						160				
161						161				
162						162				
163						163				
164						164				
165						165				
166						166				
167						167				
168						168				
169						169				
170						170				
171						171				
172						172				
173						173				
174						174				
175						175				
176						176				
177						177				
178						178				
179						179				
180						180				
181						181				
182						182				
183						183				
184						184				
185						185				
186						186				

TABLE III  
 FATIGUE TEST RESULTS - SPOTWELDED TITANIUM LAP JOINT - .025 COMMERCIALLY PURE  
 TITANIUM TO .025-.644 V SHEET COMBINATION - TWO SPOTWELDS PER JOINT

SPEC. NO.	MAXIMUM LOAD LB/SPOT	LOAD MAX. LB.	MIN. LB.	R	CYCLES TO FAILURE	REMARKS	
						FAILURE	FAILURE
1-20	250	500	25	.05	16,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS	
1-22	220	440	22	.05	39,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET	
1-2	200	400	20	.05	33,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS	
1-1	200	400	20	.05	34,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET	
1-4	200	400	20	.05	37,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS	
1-3	200	400	20	.05	41,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS	
1-5	180	360	18	.05	47,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS	
1-14	160	320	16	.05	88,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS	
1-7	160	320	16	.05	95,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET	
1-16	140	280	14	.05	105,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET	
1-6	140	280	14	.05	238,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET	
1-8	120	240	12	.05	178,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET	
1-9	120	240	12	.05	451,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET	
1-11	100	200	10	.05	384,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET	
1-10	100	200	10	.05	1,63,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET	
1-13	80	160	8	.05	1,120,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET	
1-12	80	160	8	.05	1,139,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET	
1-17	60	120	6	.05	2,911,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET	
1-18	60	120	6	.05	4,097,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET	
1-19	55	110	5.5	.05	10,174,000	SPECIMEN DID NOT FAIL	
1-21	55	110	5.5	.05	10,190,000	SPECIMEN DID NOT FAIL	

\* C.P. DESIGNATES COMMERCIALLY PURE TITANIUM.

TABLE IV  
 FATIGUE TEST RESULTS - SPOTWELDED TITANIUM LAP JOINT - .025 SAL-21SN TO .025  
 COMMERCIALLY PURE TITANIUM SHEET COMBINATION - TWO SPOTWELDS PER JOINT

SPEC. NO.	MAXIMUM LOAD LB/SPOT	LOAD MAX. LB.	MIN. LB.	R	CYCLES TO FAILURE	REMARKS
						REMARKS
2-4	309.9	618.7	48.6	.079*	11,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS
2-12	275	550	27.5	.05	19,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS
2-7	275	550	27.5	.05	21,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS
2-9	250	500	25	.05	29,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS
2-3	257.5	514.9	39.9	.078*	30,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS
2-8	225	450	22.5	.05	36,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET
2-11	225	450	22.5	.05	46,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET
2-10	200	400	20	.05	61,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET
2-2	205	410	20	.049*	65,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET
2-13	175	350	17.5	.05	89,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET
2-5	179.6	359.3	26.7	.071*	103,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET
2-6	150	300	15	.05	166,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET
2-14	140	280	14	.05	265,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET
2-20	140	280	14	.05	178,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET
2-15	120	240	12	.05	371,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET
2-16	90	180	9	.05	461,000	FAILED AT EDGE OF SPOT THRU C.P. TI SHEET
2-18	90	180	9	.05	10,081,000	SPECIMEN DID NOT FAIL
2-19	90	180	9	.05	10,218,000	SPECIMEN DID NOT FAIL
2-17	70	140	7	.05	10,009,000	SPECIMEN DID NOT FAIL

\* THESE SPECIMENS WERE RUN AT WRONG R VALUES.

\*\* C.P. DESIGNATES COMMERCIALLY PURE TITANIUM.

TABLE V  
 FATIGUE TEST RESULTS - SPOTWELDED TITANIUM LAP JOINT - .025 GALV TO .025 GALV  
 SHEET COMBINATION - TWO SPOTWELDS PER JOINT

SPEC. NO.	MAXIMUM LOAD LB/SPOT	LOAD MAX. LB.	MIN. LB.	R	CYCLES TO FAILURE	REMARKS
3-18	350	700	35	.05	9,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS
3-17	350	700	35	.05	10,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS
3-2	300	600	30	.05	12,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS
3-9	300	600	30	.05	28,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS
3-3	250	500	25	.05	41,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS
3-10	250	500	25	.05	43,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS
3-14	225	450	22.5	.05	53,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS
3-7	225	450	22.5	.05	77,000	FAILED BY NUGGET TEAR-OUT IN BOTH SHEETS
3-4	200	400	20	.05	91,000	FAILED AT EDGE OF SPOT THRU 6 ALV SHEET
3-11	200	400	20	.05	107,000	FAILED AT EDGE OF SPOT THRU 6 ALV SHEET
3-13	175	350	17.5	.05	120,000	FAILED AT EDGE OF SPOT THRU 6 ALV SHEET
3-8	175	350	17.5	.05	209,000	FAILED AT EDGE OF SPOT THRU 6 ALV SHEET
3-5	150	300	15	.05	276,000	FAILED AT EDGE OF SPOT THRU 6 ALV SHEET
3-12	150	300	15	.05	394,000	FAILED AT EDGE OF SPOT THRU 6 ALV SHEET
3-16	125	250	12.5	.05	714,000	FAILED AT EDGE OF SPOT THRU 6 ALV SHEET
3-6	125	250	12.5	.05	813,000	FAILED AT EDGE OF SPOT THRU 6 ALV SHEET
3-15	100	200	10	.05	3,508,000	FAILED AT EDGE OF SPOT THRU 6 ALV SHEET
3-19	100	200	10	.05	10,000,000	SPECIMEN DID NOT FAIL
3-1	90	180	9	.05	10,017,000	SPECIMEN DID NOT FAIL

PAGE 10		REPORT NO. 56-827	
18		APRIL 11 1957	
		DRAWING NUMBER	
SC.	NO.	SC.	NO.
TITLE		SHEAR AND TENSILE SPOTWELD SPECIMENS	
NAME		CONVAIR - SAN DIEGO	
DIVISION OF GENERAL DYNAMICS			
STRUCTURAL TEST			

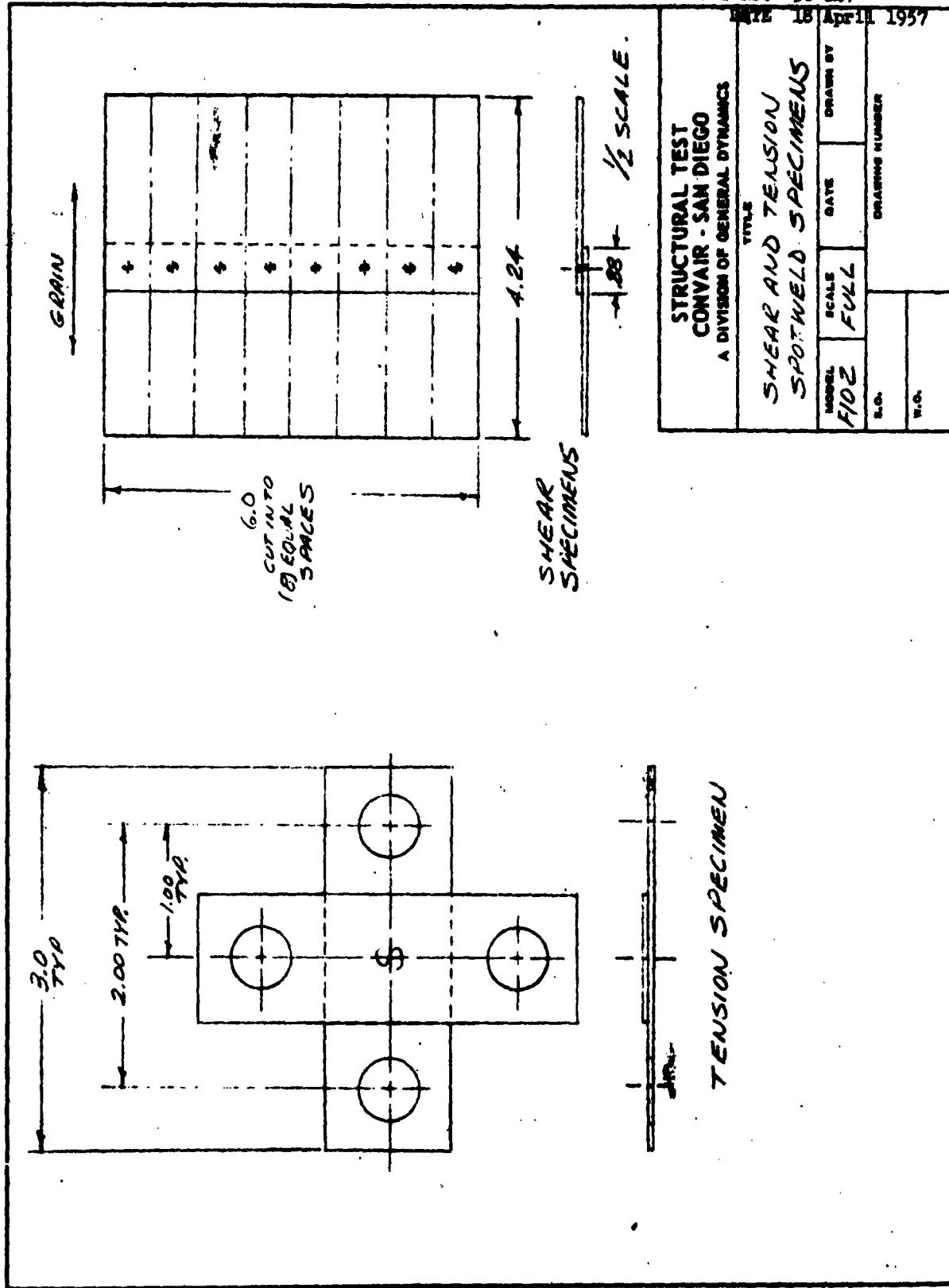
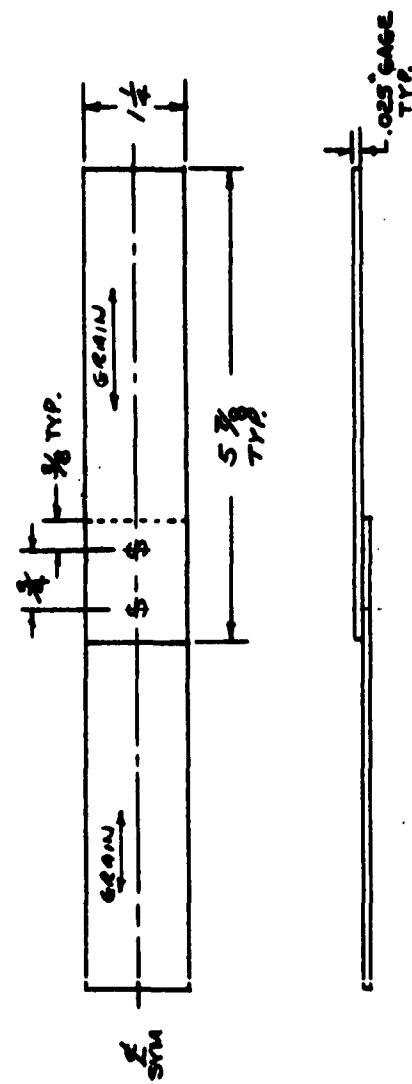


FIGURE 1.

PAGE 11  
 REPORT NO. 56-827  
 DATE 18 April 1957

STRUCTURAL TEST	
CONVAIR - SAN DIEGO	
A DIVISION OF GENERAL DYNAMICS	
TITLE	
SPOT WELD FATIGUE	
TEST SPECIMENS	
MODEL	SCALE
F102	34
S.O.	DATE
	DRAWN BY
	DRAWING NUMBER
	W.O.

CONVAIR SD - 3213



NOTES:

1. THE FOLLOWING SPECIMENS REQUIRED:
- (20) 6 Al-4 V. COMMERCIALLY PURE - TITANIUM
- (20) 5 Al-2 1/2 Sn - " "
- (20) 5 Al-2 1/2 Sn - Ga/4 V. TITANIUM.

FIGURE 2.

ANALYSIS

PREPARED BY E. K. Winslow  
CHECKED BY W. H. Wise  
REVISED BY

CONVAIR  
A DIVISION OF GENERAL DYNAMICS CORPORATION  
SAN DIEGO

PAGE 12  
REPORT NO. 56-827  
MODEL F-102A  
DATE 18 April 1957

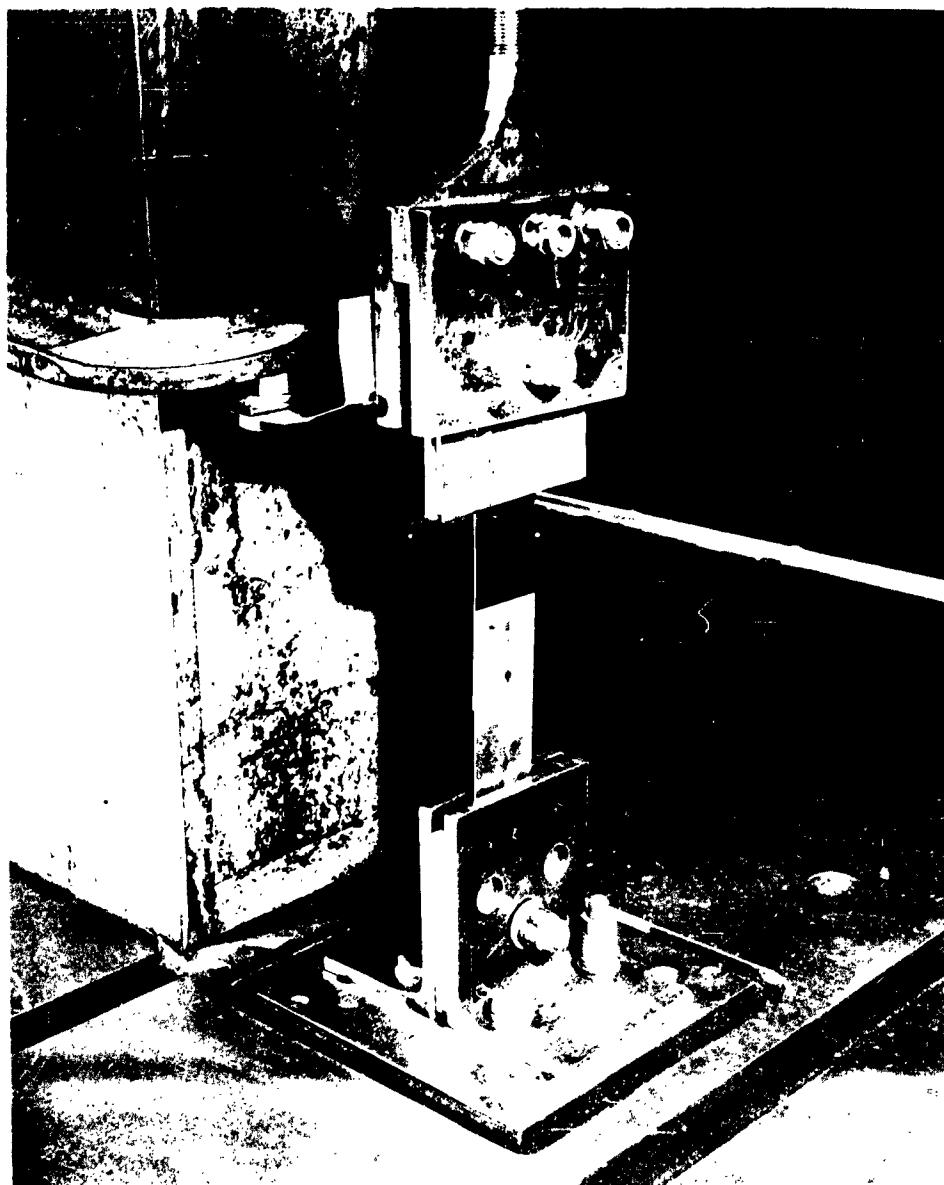


Figure 3 FATIGUE TEST SET UP

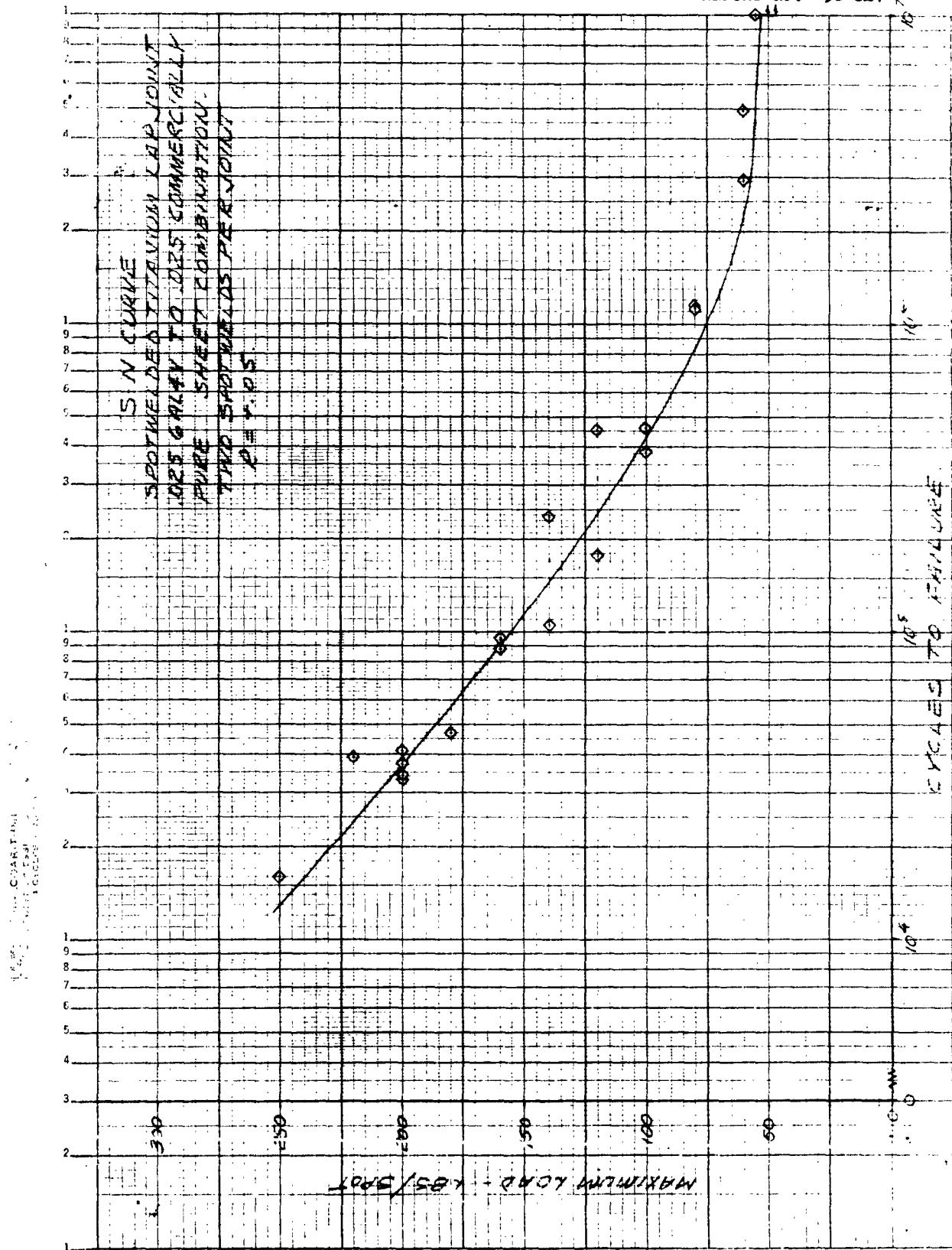


FIGURE 4

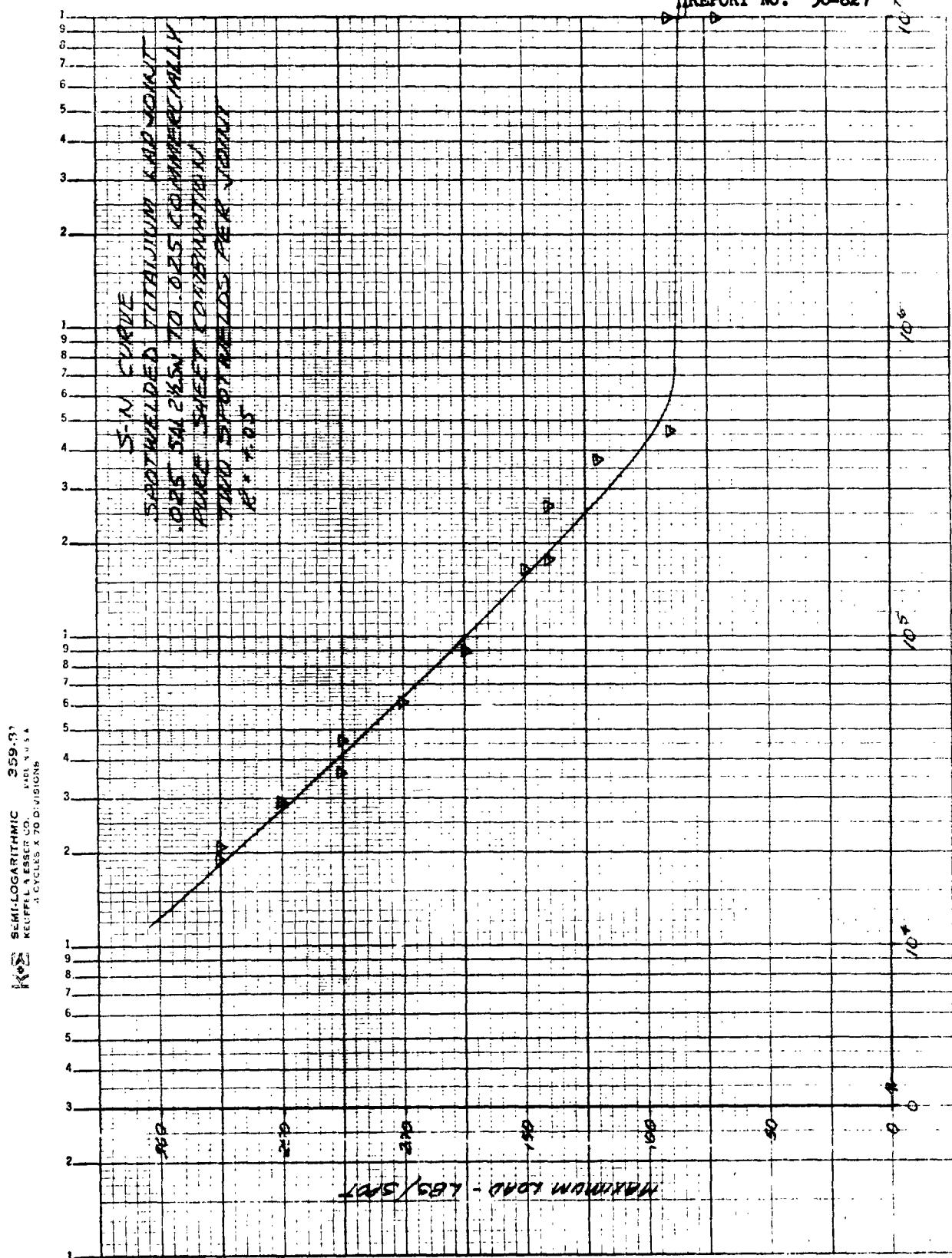


FIGURE 5

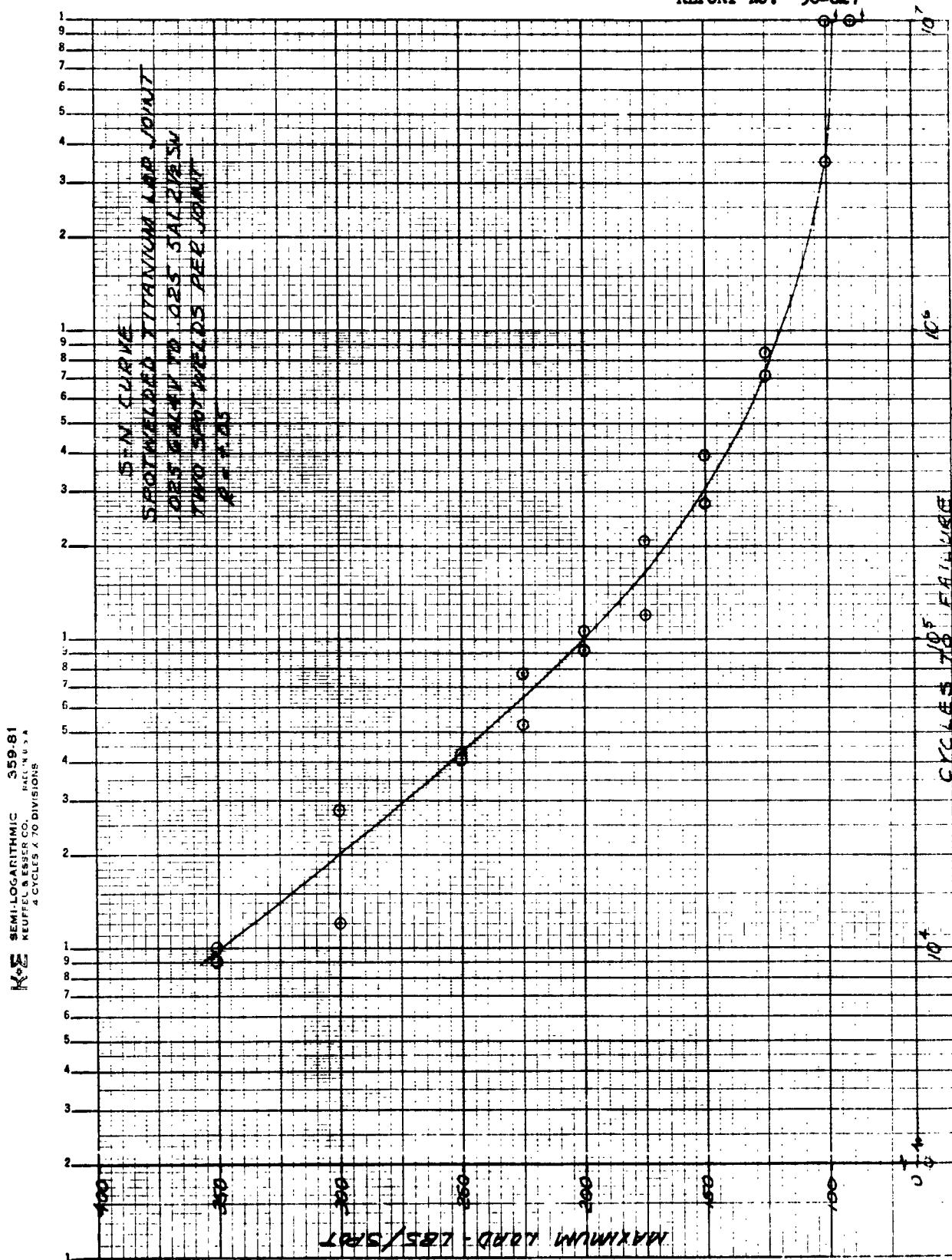


FIGURE 6

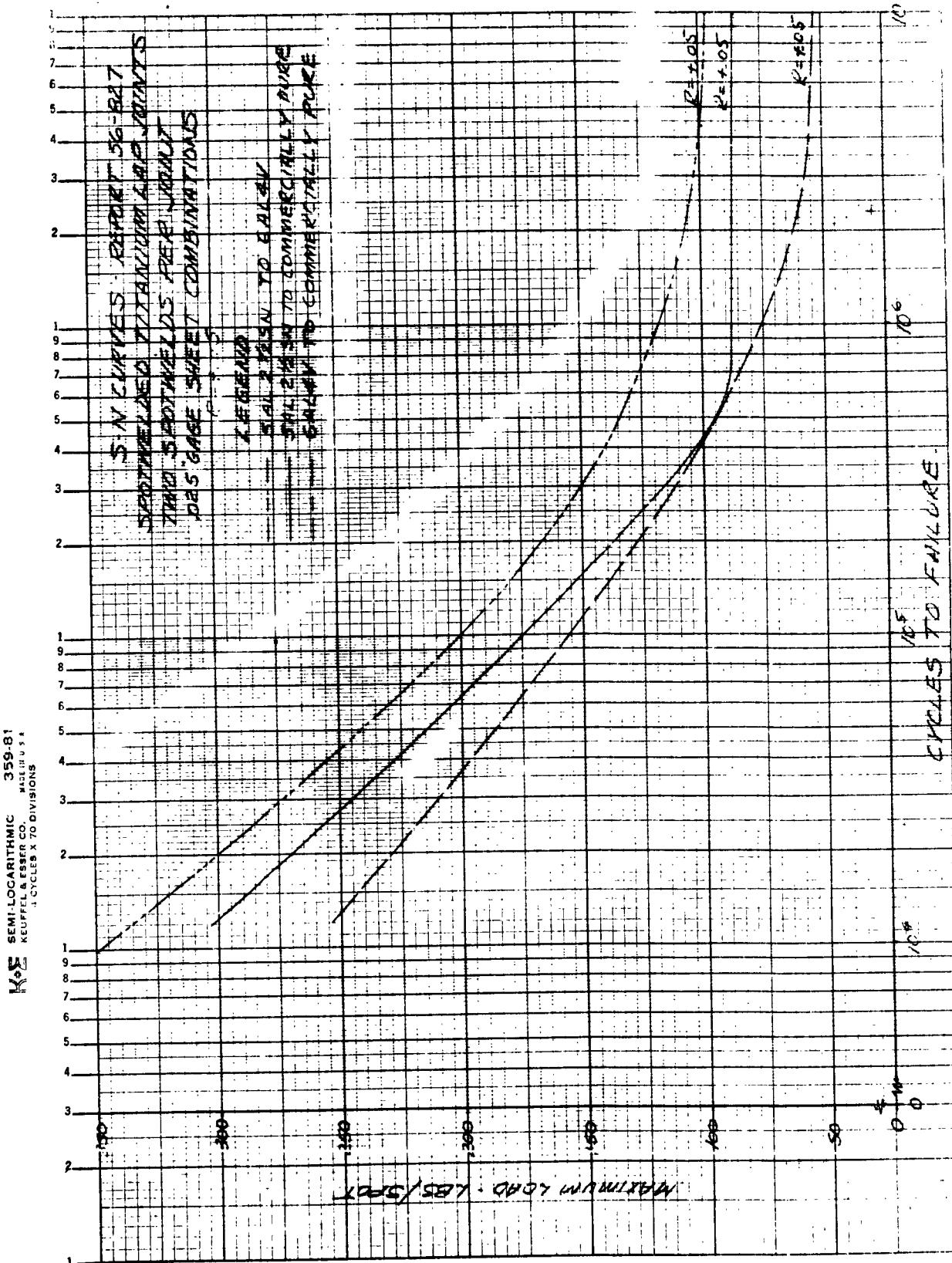


FIGURE 7

ANALYSIS  
PREPARED BY  
CHECKED BY  
REVISED BY

C O N V A

